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National Telecommunications and Information Administration
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January 15,2003

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements, IB Docket No. 99-67, RM No. 9165

Dear Ms. Dortch:

Enclosed please an original and six (6) copies of the late-filed comments of the National Telecommunications and Information Administration in the above-referenced proceeding. A diskette with a WordPerfect file of the comments is also enclosed.

Please direct any questions you may have regarding this letter to the undersigned. Thank you for your cooperation.

Respectfully submitted,

Kathy D. Smith
Chief Counsel

Enclosures

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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In the Matter of

Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements	)	IB Docket No. 99-67
Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band	)	RM No. 9165

COMMENTS OF THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

Nancy J. Victory
Assistant Secretary for
Communications and Information

Kathy Smith
Chief Counsel

Fredrick R. Wentland
Acting Associate Administrator
Office of Spectrum Management

Edward Drocella
Electronics Engineer
Office of Spectrum Management

National Telecommunications and
Information Administration
U.S. Department of Commerce
Room 4713
1401 Constitution Avenue, N.W.
Washington, DC 20230
(202) 482-1816

January 15,2003

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EXECUTIVE SUMMARY

The National Telecommunications and Information Administration (NTIA) supports the Federal Communications Commission (Commission) in its efforts to implement the international Memorandum of Understanding regarding Global Mobile Personal Communications by Satellite (GMPCS-MOU), which will support the deployment of GMPCS service in the United States and around the world. These GMPCS systems will provide additional choices for the delivery of seamless voice and data services for consumers in all parts of the world. NTIA would like to continue the arrangement established in the GMPCS Report and Order that would greatly facilitate the global roaming of mobile satellite service (MSS) mobile earth terminals (METs), while protecting critical Government operations. NTIA offers the following comments that are limited to specific technical issues raised in the GMPCS Further Notice of Proposed Rulemaking. NTIA agrees with the Commission that it generally serves the public interest to foster international uniformity in technical requirements for MSS METs. The equivalent isotropically radiated power (EIRP) limit of -80 dBW/MHz proposed by NTIA for the carrier-off state is consistent with the international standard. The NTIA proposal for carrier-off emission measurements would use the same bandwidth and detector function as used for the carrier-on emission measurements, thereby simplifying the compliance measurements. From the standpoint of interference potential to Global Navigation Satellite System (GNSS) receivers, the emission limits proposed by NTIA and the Commission achieve the same goal. However, NTIA believes that, to simplify the compliance measurements, the Commission should adopt an EIRP density of **-80** dBW/MHz for the carrier-off state emissions of MSS METs.

NTIA also recommends that the Commission specify a measurement time interval of 2 millisecond (msec) for the **MSS** MET out-of-band emission measurements in the 1559-1605 MHz band. A measurement interval of 2 msec would ensure that the emissions are measured when the MET is transmitting, while at the same time accurately quantify the interference potential to both Global Positioning System (GPS) and Wide Area Augmentation System (WAAS) receivers.

Finally, NTIA believes that failure to specify the nature **of** the detector will negatively impact compliance with the MSS MET emission limits. NTIA accordingly recommends that the Commission specify a root mean square (RMS) detector for making these measurements. The RMS emission level should be measured using an averaging time of 2 msec or less. Further, the specification of an RMS detector should be applicable to the wideband and narrowband emission limits in the 1559-1605 MHz band for both the carrier-on and carrier-off states of the **MSS** METs.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
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COMMENTS OF THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

The National Telecommunications and Information Administration (NTIA), an Executive Branch agency within the Department of Commerce, is the President’s principal adviser on domestic and international telecommunications policy, including policies relating to the Nation’s economic and technological advancement in telecommunications. Accordingly, NTIA makes recommendations regarding telecommunications policies and presents Executive Branch views on telecommunications matters to the Congress, the Federal Communications Commission (Commission), and the public. NTIA, through the Office of Spectrum Management, is also responsible for managing the Federal Government’s use of the radio frequency spectrum. NTIA respectively submits the following comments in response to the Commission’s Report and Order and Further Notice of Proposed Rulemaking in the above-captioned proceeding.’

[1] ***Amendments of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements and Petition of the National Telecommunications***

I. INTRODUCTION

The Report and Order (R&O) establishes rules to facilitate the global operation of mobile earth-station terminals (METs) used for mobile satellite service (MSS) communications? The rules pertaining to worldwide circulation of METs were designed to implement an international Memorandum of Understanding (MOU) regarding Global Mobile Personal Communications by Satellite (GMPCS-MOU), which was signed by the United States and over 120 additional parties in February 1997. The R&O also establishes out-of-band emission limits for MSS METs operating in the 1610-1660.5 MHz and 1990-2025 MHz bands.

NTIA filed comments and reply comments in response to the issues raised in the GMPCS Notice of Proposed Rulemaking (NPRM).[3] NTIA's comments addressed such areas as: 1) MSS MET out-of-band emission limits necessary to protect Global Navigation Satellite Service (GNSS) aviation receivers: 2) measurement techniques for compliance; **3)** emission limits for MSS METs in the carrier-off state; and 4) requirements for position location capabilities for

and Information Administration to ***Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band,*** Report and Order and Further Notice of Proposed Rulemaking, IB Docket No. 99-67 and RM No. 9165, FCC 99-37 (rel. May 14,2002) (hereinafter "GMPCS R&O/FNPRM").

[2] ***Amendments of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements and Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band,*** Notice of Proposed Rulemaking, IB Docket No. 99-67 and RM No. 9165, FCC 99-37 (rel. March 5, 1999).

[3] Comments of the National Telecommunications and Information Administration, IB Dkt. 99-67 (June 21, 1999) (hereinafter "NTIA Comments"); Reply Comments of the National Telecommunications and Information Administration, IB Dkt. 99-67 (**July** 21, 1999).

[4] The GNSS includes the United States Global Positioning System (GPS), the Russian Global Navigation Satellite System (GLONASS), Space Based Augmentation System (SBAS), and Ground Based Augmentation Systems (GBAS). In the United States, the SBAS is the Wide Area Augmentation System (WAAS) and the GBAS is the Local Area Augmentation System (LAAS). The augmentation systems are capable of supporting both GPS and GLONASS signal formats.

GMPCS terminals authorized in the United States. The rules adopted by the Commission governing the out-of-hand emissions for MSS METs were in accordance with NTIA's recommendations. There were also several technical issues raised in the comments and reply comments that the Commission believed required further consideration in this proceeding. The Commission issued a Further Notice of Proposed Rulemaking (FNPRM) requesting additional public comment on those technical issues.

NTIA supports the Commission in its efforts to implement the international GMPCS-MOU, which will support the deployment **of** GMPCS service in the United States and around the world. These GMPCS systems will provide additional choices for the delivery of seamless voice and data services for consumers in all parts of the world. NTIA offers the following comments that are limited to specific technical issues raised in the GMPCS FNPRM.[5]

II. THE NTIA PROPOSAL FOR CARRIER-OFF EMISSION LIMITS WILL SIMPLIFY THE COMPLIANCE MEASUREMENTS FOR MSS METS.

In response to the GMPCS NPRM, NTIA filed comments recommending that the Commission adopt a limit for the MSS MET when it is in the carrier-off (*e.g.*, stand-by) state.[6] In the carrier-off state, an MSS MET is powered-on but does not transmit a signal. Obviously, the carrier-off state emissions should be held to levels lower than those for the carrier-on state. Consistent with this, the emission limit for the carrier-off state recommended by NTIA was an equivalent isotropically radiated power (EIRP) density of -80 dBW/MHz in the 1559-1605 MHz

[5] The NTIA comments address the MSS MET carrier-off emission limits specified in the 1559-1605 MHz band for the protection of GNSS aviation receivers. They do not address the carrier-on emission limits, nor the protection of terrestrial (ground-based) **GPS** receivers.

[6] NTIA Comments at **22,**

band - - 10 dB lower than the limit for the carrier-on state. As with the carrier-on state of the MSS METs, the emission levels for the carrier-off state should be measured using an average detector function.

The Commission agreed with NTIA that a limit on the emissions of an MSS MET in the carrier-off state was necessary.[7] Since the issue of an emission limit for the carrier-off state was not included in the GMPCS NPRM, the Commission in the FNPRM proposed a value for carrier-off emission limits and invited public comment.' However, the value proposed by the Commission was not the emission limit proposed by NTIA, but rather a peak EIRF' density of -77 dBW/100 kHz - - a value consistent with an International Telecommunication Union-Radiocommunications Sector (ITU-R) recommendation.'

NTIA continues to urge the Commission to adopt an EIRP limit of -80 dBW/MHz for carrier-off emissions, rather than the -77 dBW/100 kHz limit proposed. The -80 dBW/MHz value is also consistent with the ITU-R recommendation and will greatly simplify the compliance measurements. As explained below, there are two technical differences between the **NTIA** proposal and the international standard proposed by the Commission for carrier-off emissions: 1) the measurement bandwidth; and 2) the detector function of the measurement equipment.

The measurement bandwidth for the emission limit proposed by NTIA is 1 MHz. The measurement bandwidth specified in ITU-R Recommendation M.1343 is 100 kHz. The

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[7] GMPCS R&O/FNPRM at ¶82.

[8] ***Id.***

[9] Recommendation ITU-R M.1343, Essential Technical Requirements of Mobile Earth Stations for Global Non-Geostationary Mobile-Satellite Service Systems in the Bands 1-3 GHz (hereinafter "ITU-R M.1343").

Value	Remarks
-77 dBW/100 kHz	Commission proposal for carrier-off emission level
10 dB	Conversion from 100 kHz to 1 MHz measurement bandwidth
-13 dB	Peak to average ratio for noise-like signals
-80 dBW/MHz	NTIA proposal for carrier-off emission level

As shown in Table 1, the value proposed by NTIA for the emission level of **MSS** METs in the carrier-off state is consistent with the international specification proposed by the Commission.

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[10] **ITU-R M.1343 at 9**

[11] M. Engelson, ***Modern Spectrum Analyzer Measurements*** **(1991) at 73**

[12] **Report** No. **FAA-RD-72-80** I, ***Radio Frequency Emission Characteristics and Measurement Procedures of Incidental Radiation Devices and Industrial, Scientific and Medical Equipment*** **(Sept. 1972) at 2-38.**

NTIA agrees with the Commission that it generally serves the public interest to foster international uniformity in technical requirements for MSS METs. NTIA believes that the EIRP limit **of** -80 dBW/MHz proposed for the carrier-off state is consistent with the international standard. The NTIA proposal for carrier-off emission measurements would use the same bandwidth and detector function as used for the carrier-on emission measurements, thereby simplifying the compliance measurements. From the standpoint of interference potential to GNSS receivers, the emission limits proposed by NTIA and the Commission achieve the same goal. However, NTIA believes that, in an effort to simplify the compliance measurements, the Commission should adopt an EIRP density **of** -80 dBW/MHz in the 1559-1605 MHz band for the MSS METs in the carrier-off state.

III. THE COMMISSION SHOULD ADOPT A MEASUREMENT TIME INTERVAL OF 2 MILLISECONDS FOR ALL MSS MET EMISSION MEASUREMENTS.

In response to the GMPCS NPRM, NTIA recommended that the Commission adopt a measurement interval for the MSS MET out-of-band emission levels in the 1559-1605 MHz band. For Code Division Multiple Access (CDMA) MSS METs, NTIA recommended that the emissions be measured over a 20 millisecond (msec) time interval.” NTIA recommended that for Time Division Multiple Access (TDMA) MSS METs, the emission levels be measured over a time interval of duration that is equal in length to the transmission time slot.[14] The Commission declined to adopt a measurement interval less than the 20 msec specified in ITU-R Recommendation M.1343. However, the Commission requested further comment on the

[13] NTIA Comments at IS.

[14] ***Id.***

recommendation for shorter measurement intervals, specifically a time interval of 2 msec.[15]

As discussed in NTIA's comments to the GMPCS NPRM, the 20 msec measurement time interval in ITU-R Recommendation M.1343 was based on the 50 bits/second data rate of the Global Positioning System (GPS) navigation message.[16] The Federal Aviation Administration is developing the Wide Area Augmentation System (WAAS) to provide augmentation to GPS, enabling users to navigate the en-route through precision approach phases of flight. The **WAAS** signal provides: 1) integrity data on GPS and Geostationary Earth Orbit (GEO) satellites; 2) differential corrections to GPS and GEO satellites to improve accuracy; and **3)** a ranging capability to improve availability and continuity.[17] In order to transmit the additional integrity data, ionospheric correction data, and GPS clock error data, the WAAS signal has a higher data rate than the GPS signal. The WAAS signal is modulated with data using a symbol rate of 500 bits/second, which has a corresponding bit duration of 2 msec (11500). ITU-R Recommendation M.1343 did not include a provision for the WAAS signal because it was still in the early developmental stages when the recommendation was debated internationally. However, as WAAS has continued to develop, the need to protect its signal has been recognized in both national and international standards fora."

[15] GMPCS R&O/FNPRM at ¶85

[16] NTIA Comments at 17. The bit duration is the inverse of the data rate

[17] Department of Defense and Department of Transportation, ***2001 Federal Radionavigation Plan*** at 3-5.

[18] Document RTCA/DO-235, ***Assessment of Radio Frequency Interference Relevant to the GNSS*** (Jan. 21, 1997) at Appendix C; International Telecommunication Union Radiocommunication Sector Recommendation ITU-R M.1477, ***Technical and Performance Characteristics of Current and Planned RNSS (Space-to-Earth) and ARNS Receivers to be Considered in Interference Studies in the Band 1559-1610 MHz***, at Table 1.

The initial intent of NTIA's recommendation to specify a measurement interval was to ensure that the out-of-band emission measurements were performed while the MSS MET was transmitting. This is consistent with the guidance provided in ITU-R Recommendation M.1343, which specifies that for non-continuous signals the measurement should be performed over the active part of the burst." For CDMA METs, the emissions will be continuous, so performing the emission measurement while the MET is transmitting should not be a problem. However, TDMA METs transmit data by dividing the channel into time slots with an on-time and an off-time. NTIA believes that the MET emissions should be measured during the transmission time slot on-time and should not include the off-time of the transmission time slot. NTIA also believes that in order to properly assess the potential for interference, the MSS MET emissions should be measured over a time interval that is related to the bit durations of the GPS and **WAAS** signals. This would be consistent with the approach used in ITU-R Recommendation M.1343 to establish the measurement time interval.

Accordingly, NTIA recommends that the Commission specify a measurement time interval of 2 msec for the MSS MET out-of-band emission measurements in the 1559-1605 MHz band. A measurement interval of 2 msec would ensure that the emissions are measured when the MET is transmitting, while at the same time accurately quantifying the interference potential to both GPS and WAAS receivers.

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[19] ITU-R **M.1343 at** Table 1

IV. THE COMMISSION SHOULD SPECIFY THAT WIDEBAND AND NARROWBAND MSS MET OUT-OF-BAND EMISSIONS BE MEASURED USING AN RMS DETECTOR.

ITU-R Recommendation M.1343 specifies that the out-of-band emissions for MSS METs are to be measured using average responding instruments?' There are several common detector functions that can be used to perform average power measurements. The Commission realized this and requested comments as to whether the wideband power spectral density measurements could vary significantly depending on the detector function employed, and if so, whether the Commission should prescribe the use of a particular type of detector for testing compliance with the wideband emission limits.''

There are several detector functions that can be used for average power measurements: 1) logarithmic average; 2) linear average; or **3)** root mean square (RMS). ITU-R Recommendation M.1343 does not give a strict definition of the detector function to be used for the MSS MET out-of-band emission measurements. Depending on the signal statistics of the out-of-band emissions, the measurement result will depend on the detector function selected. The interference impact to GPS receivers is quantified in terms of average power. Only the RMS detector will consistently measure the true average power of the emission level.

Detector functions tend to emphasize particular parts of the time waveform being measured. The logarithmic average detector function gives greatest weight to the relatively lower values in the time waveform and thus discounts voltage peaks or spikes. The linear average detector function tends to be more affected equally by the whole range of signal values. The

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[20] ITU-R **M.1343** at Table 1.

[21] **GMPCS** R&O/FNPRM **at** ¶85.

RMS detector function relates to the "voltage-squared" values of the time waveform, and as such tends to be more affected by the higher signal levels of the waveform. However, this voltage-squared aspect is a measurement of the true average power of the signal. For Gaussian noise where the peak values are typically 10 to 14 dB higher than the average levels, the RMS value is 1.05 dB above the linear average and 2.5 dB above the logarithmic average?' This divergence in measured values for the various detector functions would be even greater for signals that contain mostly spikes, such **as** out-of-band emissions from low duty cycle pulsed or impulse systems. A study performed by NTIA's Institute for Telecommunication Sciences examined the effect of using different detector functions to measure noise-like, pulse-like, and continuous-wave signals and reached similar conclusions.[23]

For CDMA signals (*e.g.*, CDMA Digital Cellular Standard IS-95), the out-of-band emissions appear similar to Gaussian noise, but their signal statistics are not equal to Gaussian noise. Thus, there are differences between **the** RMS, logarithmic, and linear average measurements of the signal. The RMS value **of** an IS-95 signal is more than 1.05 dB above the linear average and more than 2.5 dB above the logarithmic **average.**[24] However, the RMS value is a measure of the theoretically defined average power.

While the logarithmic average is sometimes used vernacularly in an interchangeable sense with the term "average power," it is clear that the average decibel level emitted by a

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[22] *Id.*

[23] NTIA Report 01-383, ***The Temporal and Spectral Characteristics of Ultrawideband Signals,*** National Telecommunications and Information Administration, Institute for Telecommunication Sciences (Jan. 2001) at 8-13.

[24] OOB Emissions at **2.**

transmitter is not equal to the RMS average output power level. As a consequence of these differences, if the choice of the detector used is left open to the user of the specification, the result would depend on the detector chosen. Such variation is clearly not acceptable for performing compliance measurements.

The interference impact to GNSS receivers is most accurately determined by the average power. A true representation of average power can be made using an RMS detector. In the past, RMS detectors were not commonly available in spectrum analyzers, at least not for measurements over a wide dynamic range. This is the main reason for the use of other detector functions. However, in 2000 and early 2001, spectrum analyzers with integrated RMS detectors became available on the commercial market?' There are also methods of using commercial-off-the-shelf equipment to measure RMS emission levels. Appendix A describes different measurement procedures that can be used for performing RMS measurements.

The Commission's inquiry on measurement detector functions only addresses the measurement of the wideband emission limit. However, in the R&O, the Commission adopted NTIA's recommendation for a narrowband emission limit.[26] NTIA believes that there is no reason why an RMS detector should not also be used for the narrowband emission compliance measurements.

NTIA accordingly recommends that the Commission specify an RMS detector for the emission limit measurements for MSS METs. The RMS measurement should be measured using an averaging time of 2 msec or less. The specification of an RMS detector should be applicable

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[25] ***Id* at 6-23.**

[26] GMPCS R&O/FNPRM at ¶23.

to the wideband and narrowband emission limits in the 1559-1605 MHz band for both the carrier-on and carrier-off states of the MSS MET.

V. CONCLUSION

For the foregoing reasons, NTIA urges the Commission to adopt a carrier-off state EIRP limit of -80 dBW/MHz for MSS METs, to specify a measurement time interval of 2 msec during the MET transmission for emission limit measurements, and to require the use of an RMS detector for emission limit measurements. These recommendations would greatly facilitate the global roaming of MSS terminals, while protecting critical Government operations.

Respectfully submitted,

Kathy Smith

Kathy Smith
Chief Counsel

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Assistant Secretary for
Communications and Information

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APPENDIX A
RMS Measurement Procedures

The average power measurement based on RMS voltage can be accomplished by using a spectrum analyzer that incorporates an RMS detector. The resolution bandwidth of the spectrum analyzer should be set to 1 MHz, the RMS detector selected, and a measurement averaging time of 2 msec or less is used. If the transmitter employs transmission time slots (e.g., TDMA) in which the transmitter is quiescent for intervals of time, all measurements shall be made while the transmission time slot is on.

Alternatively, a RMS level can also be measured using a spectrum analyzer that does not incorporate a RMS detector. This approach requires a multiple step technique beginning with a peak detection scan of the 1559-1605 MHz band with a resolution bandwidth of **1** MHz and a video bandwidth of no less than 1 MHz. The resulting spectrum analyzer trace is to be used to identify the frequency and bandwidth of the five highest peaks in the emission spectrum. The spectrum analyzer is then placed in a "zero span" mode, with a resolution bandwidth of 1 MHz, a video bandwidth equal to or greater than 1 MHz, and a detector selected that does not distort or smooth the instantaneous signal levels (e.g., **a** sample detector). With these settings, a minimum of ten independent instantaneous points, representing the highest amplitude readings, are to be obtained during the time that a transmission is present, in each 1 MHz frequency bin across the bandwidth of each of the five highest peaks identified in the previous step. The data obtained from these measurements must then be post-processed to determine the average power based on RMS voltage levels. The average power in Watts is determined by:

$$P_{RMS} = \frac{V_{RMS}^2}{R} \qquad \text{A-1}$$

where:

V_{RMS} is the RMS voltage (volts);
R is the resistance (50 Ohms).

The RMS voltage is computed by:

$$_{RMS} = \sqrt{\frac{V_1^2 + V_2^2 + \ldots. V_n^2}{n}} \qquad \text{A-2}$$

where:

V,, V_2, V_n are the voltage amplitudes to be averaged (volts);
n is the number of voltage amplitudes.

The post-processing of the data can be performed manually or with the aid of appropriate software.